

CLAIMS

1. An electrochemical cell comprising:
  - (a) a cathode comprising an electroactive sulfur-containing material;
  - (b) an anode comprising lithium; and
  - (c) a nonaqueous electrolyte:wherein the cell exhibits utilization of the electroactive sulfur-containing material of at least 60 % and a charge-discharge efficiency of at least 80 % over at least 10 cycles at a charge rate of about 0.2 mA/cm<sup>2</sup> and a discharge rate of about 0.4 mA/cm<sup>2</sup>.
2. The cell of claim 1 wherein the electrolyte comprises:
  - (i) one or more nonaqueous solvents selected from the group consisting of acyclic ethers, cyclic ethers, polyethers, and sulfones; and
  - (ii) one or more N-O additives.
3. The cell of claim 2 wherein the electrolyte further comprises one or more lithium salts.
4. The cell of claim 1 that exhibits a charge-discharge efficiency of at least 90%.
5. The cell of claim 1 that exhibits utilization of the electroactive sulfur-containing material of at least 60% over at least 20 cycles at a discharge rate of about 0.4 mA/cm<sup>2</sup>.
6. The cell of claim 1 that exhibits utilization of the electroactive sulfur-containing material of at least 60% over at least 50 cycles at a discharge rate of about 0.4 mA/cm<sup>2</sup>.
7. The cell of claim 6 that exhibits a charge-discharge efficiency of at least 90% at a discharge rate of about 0.4 mA/cm<sup>2</sup>.
8. The cell of claim 3 that exhibits utilization of the electroactive sulfur-containing material of at least 60% over at least 20 cycles at a discharge rate of about 2.8 mA/cm<sup>2</sup>.
9. The cell of claim 2 wherein the one or more N-O additives is selected from one or more of the group consisting of inorganic nitrates, organic nitrates, and inorganic nitrites.
10. The cell of claim 3 wherein the one or more N-O additives is selected from one or more of the group consisting of inorganic nitrates, organic nitrates, inorganic nitrites, and organic nitro compounds.
11. The cell of claim 10 wherein the inorganic nitrate is selected from one or more of the group consisting of lithium nitrate, potassium nitrate, cesium nitrate, barium nitrate, and ammonium nitrate.
12. The cell of claim 10 wherein the inorganic nitrite is selected from one or more of the group consisting of lithium nitrite, potassium nitrite, cesium nitrite, and ammonium nitrite.

13. The cell of claim 3 wherein the organic nitrate is selected from one or more of the group consisting of guanidine nitrate, imidazolium nitrate, and pyridinium nitrate.
14. The cell of claim 10 wherein the organic nitro compound is selected from one or more of the group consisting of nitromethane, nitropropane, nitrobenzene, dinitrobenzene,  
5 nitrotoluene, dinitrotoluene, nitropyridine, nitrobutanes and dialkyl imiazolium.
15. The cell of claim 3 wherein the one or more lithium salts is selected from one or more of the group consisting of LiSCN, LiCF<sub>3</sub>SO<sub>3</sub>, and LiN(CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>.
16. The cell of claim 3 wherein the one or more lithium salts consist of LiSCN and LiN(CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub> and the N-O additive comprises lithium nitrate.
- 10 17. The cell of claim 2 wherein the concentration of the one or more N-O additives in the electrolyte is from about 0.02 m to 2.0 m.
18. The cell of claim 2 wherein the concentration of the one or more N-O additives in the electrolyte is from about 0.1 m to 1.5 m.
19. The cell of claim 2 wherein the concentration of the one or more N-O additives in the  
15 electrolyte is from about 0.2 m to 1.0 m.
20. The cell of claim 2 wherein the concentration of the one or more lithium salts in the electrolyte is from about 0.2 m to about 2.0 m.
21. The cell of claim 1 wherein the electroactive sulfur-containing material comprises elemental sulfur.
- 20 22. The cell of claim 1 wherein the anode comprises lithium metal.
23. The cell of claim 1 that further includes a separator interposed between the anode and the cathode.
24. A battery comprising a casing and one or more cells of claim 1.
25. The cell of claim 2 wherein the one or more N-O additives is lithium nitrate.
- 25 26. The cell of claim 2 wherein the nonaqueous solvent comprises dioxolane.
27. The cell of claim 2 wherein the one or more solvents consists of dimethoxyethane and dioxolane.